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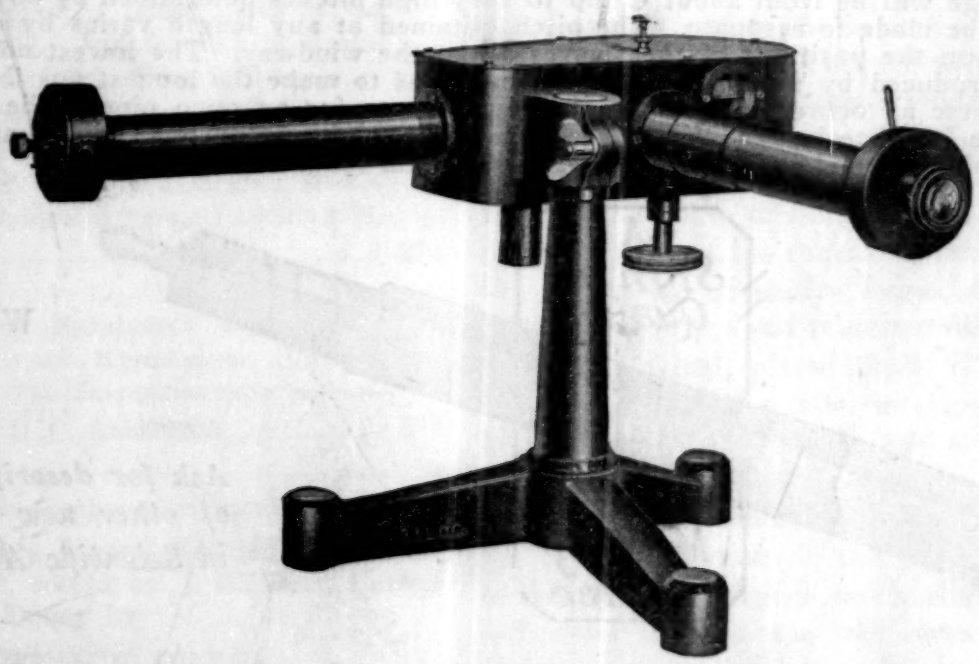

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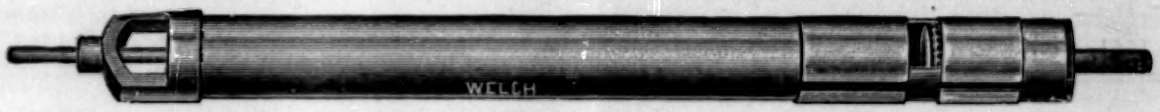

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Science News x

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THE EVOLUTION OF INTERNATIONALISM[1]

THE evolution of internationalism is an interesting and very important study which will engage the attention of some of the best minds in the world more and more as time goes on. The interdependence of people and races of people is showing itself in new ways every year. The world is not yet overpopulated. In a strictly biological sense it will never be overpopulated by the human species or any other species. The old principle of "the balance of nature" is sure to prevail. The word *overpopulation* implies something unnatural—something beyond nature's laws—something that nature herself will correct; in other words, it is an impossible happening. Remember distinctly, please, that this is simply a broad biological deduction!

Yes, nature's restoration of the balance is inevitable. The species that have passed the great inexorable limit law must be reduced; the surplus must starve for lack of food. If the offending form should be the human species, with its wonderful intelligence, with the culture it has laboriously gained, with its high ideals, with its misty sense of spirituality, it will make no difference to nature; she will grind on and restore the balance.

The human species is utterly selfish, like any other species; but this selfishness tends to become more broadly a *species* selfishness as the years go by and conditions are more broadly understood, having passed through the stages of the selfishness of the individual, of the family, of the community, and, let us hope, of the nation—all successive stages, and all fundamentally based on the self-preservation instinct or desire of the individual, placed there by nature.

Love of kind is a late development, and love of kind in its purest form has been a powerful advocate leading forward to internationalism. But, just as the desire for continued existence with the individual has led to the evolution of the present social complex, to the growth of nations, so the continually increasing difficulties of existence lead onward to the species selfishness—the desire to maintain the human species in control of all resources of the planet on which it finds itself.

Thus, conservation of the world's resources, the movement which is expressed by this conference, attended as it is by many men of many nations, is an

[1] Opening remarks of the chairman of the First Pan-Pacific Conservation Congress, Honolulu, Hawaii, July, 1924.

idea based upon what may be termed *species* selfishness. The human species has a collective mind, and thus has an immense advantage over the other forms that have come into this world, and so, finding itself at war with its surroundings, it has an enormous advantage over other animals in being able to work out plans for the subjugation of nature, in being able to modify many forms of plant and animal life, in being able actually to domesticate many of them, as against the immensely slow working of the forces of adaptation acting with other species.

It is quite true that in the course of ages this evolutional adaptation has given the vastly older forms of life a very great advantage over the human species. Hundreds of thousands of species of insects, for example, are far better adapted to continued existence upon the earth than is the human species; but the birth of intelligence, of the human mind when it is put to collective use, places man in control and enables him, in spite of his poorly adapted physique, to assume the commanding place.

There are, of course, regions where the war against nature is less strenuous than in others, regions in which the fighting and resistant qualities have not been demanded as in other regions. Compare the conditions which were met by my own ancestors, when they landed on the frightful coast of New England three hundred years ago, with those met by the first visitors to some of these friendly islands of the Pacific. With the former, life was a keen struggle; with the latter, the environment of nature was friendly, smiling, welcoming.

The time has never been, however, when the interests of man everywhere have not been theoretically interdependent; and in the later years we have seen the great coming-together movement, the mutually helpful movement, take form and grow more and more rapidly. It is a movement which is daily becoming more necessary for the well-being of the human species. Just how important this is—just how necessary it is for the best minds of all nations to come together in international conservation conferences like this—becomes more appallingly obvious year by year as the world's population continues to increase at such a rate that ninety years hence it will have reached four billions.

In my own country, the United States, out of a total land area of 1,903,000,000 acres, 478,000,000 acres were in cultivation in 1910. One hundred million people are supported comfortably now, and 135,000,000 can be supported eventually if our agriculture is efficient. With the steadily increasing population (even without immigration) the present productivity must be increased 50 per cent. if our people in the very near future are to have the present food standard. This may be brought about by the irrigation of 30,000,000 acres of desert, by the drainage of 60,000,000 acres of swamps, by the utilization of 82,000,000 acres for dry farming; and part of our 150,000,000 acres of forests may have tillable land. Then, too, the food resources of our lakes, streams and ocean coast waters can be increased. The enormous loss to our agriculture from injurious insect and plant diseases can be and must be very greatly decreased. To-day we are planting thousands upon thousands of acres for the benefit of the insect rather than of ourselves. And the appalling waste that is still going on! That largely can be stopped.

Professor E. M. East, of Harvard, in a recent book entitled "Mankind at the Crossroads," points out that in a little over a century the earth may be inhabited by 5,200,000,000 people, and in such a case he prophesies, "the world would be filled with a seething mass of discontented humanity struggling for mere existence." East argues that the fertile regions of temperate Asia and the major part of Europe are already overpopulated; that "North America is entering a stage when exportation of food is no longer possible; Australia will reach the same stage within a few decades, and temperate South America will follow Australia before the present generation passes on." His conclusion is, "Within half a century presumably, within a century certainly, each country must prepare to live upon the fruits of its own agricultural efforts."

Is this too dismal a picture? If so, what can be done to prevent this future? Scientific birth control has been advocated. To the biologist, that is a plan of many merits, which, could it ever generally be agreed upon and enforced, without doubt would make for the improvement of the human race and greatly would retard the arrival of the dreaded years of disastrous overcrowding.

But, aside from birth control, the sum of human intelligence, the cooperation of the best brains, the pushing of human inventiveness, will result not only in better conserving the world's resources for the benefit of humanity, but in increasing them in ways that are not dreamed about as yet. This is the idea that must be stressed from now on. This is the controlling idea of this conference. This is the idea which will bring the thinkers of many nations together with increasing frequency in the years to come. This is the idea which, in its fullest action, will preserve for the human species its present commanding place on this planet, let us hope for many centuries to come.

L. O. HOWARD

HONOLULU, HAWAII

THE PAN-PACIFIC FOOD CONSERVATION CONFERENCE

THE Food Conservation Conference held at Honolulu July 31 to August 14, 1924, under the auspices of the Pan-Pacific Union, was an event of more than ordinary interest to every country bordering on the Pacific.

There were more than 140 delegates present, representing practically every country of the Pan-Pacific Union. Countries that were particularly well represented were New Zealand, Australia, the Netherlands, East Indies, Siam, China, Japan, the Philippines and the United States. Several of the delegates were men well known internationally; among these may be mentioned the Honorable George M. Thomson and the Honorable Mark Cohen, of New Zealand; Sir Joseph Carruthers, ex-premier of New South Wales; Dr. Hippolyte Damiens, administrator in chief of Indo-China; Dr. Rodrigo Rodrigues, governor of Macao; Dr. Hugh M. Smith, advisor in fisheries to the King of Siam; Dr. Koliang Yih, Chinese consul general at San Francisco; Dr. Ken Harada, secretary League of Nations; Dr. K. Kishinouye, professor of fisheries, Imperial University of Tokyo; Dr. Rokuichiro Matsujima, first president of the International Bar Association; Sanford B. Dole, first president of the Republic of Hawaii, and Dr. David Starr Jordan, international authority on fisheries.

Among the delegates and others in attendance from America may be mentioned the following: Dr. E. W. Allen, chief, Office of Experiment Station, U. S. Department of Agriculture, Washington, D. C.; Dr. Carl L. Alsberg, director Food Research Institute, Carnegie Corporation, Stanford University, California; John Pierce Anderson, Red Wing, Minnesota; Miss Louise A. Anderson, Red Wing, Minnesota; M. De Arango, chemical engineer, 67 Wall Street, New York; Dr. E. W. Brandes, pathologist in charge sugar plant investigations, U. S. Department of Agriculture, Washington, D. C.; Dr. F. A. Bushe, representing University of Colorado, Boulder, Colorado; Dr. Mary Page Campbell, California Academy of Sciences, San Francisco; Harry Chandler, representing Los Angeles Chamber of Commerce; Dr. Royal Norton Chapman, associate professor of animal biology and entomology, University of Minnesota; Dr. T. D. A. Cockerell, professor of zoology and entomology, University of Colorado; Hon. John C. Cope, Portland, Oregon; M. Viscount G. de la Jarrie, director of Bureau of French Colonial Information, New York; Miss Alice Eastwood, curator of botany, California Academy of Sciences; Dr. Henry A. Erikson, chairman, department of physics, University of Minnesota; Dr. Barton Warren Evermann, delegate representing the California Academy of Sciences, the Pacific Division of the American Association for the Advancement of Science and the San Francisco Chamber of Commerce; Dr. Fred Denton Fromme, professor of plant pathology and bacteriology, Virginia Polytechnic Institute, Blacksburg, Virginia; Dr. T. C. Frye, professor of botany, University of Washington; Dr. Ross Aiken Gortner, chief, division of biochemistry, University of Minnesota, representing the university and the Minnesota Agricultural Experiment Station; Dr. Lawrence E. Griffin, professor of biology, Reed College, representing Chamber of Commerce, Portland, Oregon; Dr. J. Arthur Harris, head department of botany, University of Minnesota; Dr. William B. Herms, head division of entomology and parasitology, University of California; Dr. L. O. Howard, chief, Bureau of Entomology, U. S. Department of Agriculture; Dr. Claude S. Hudson, consulting chemist, Bureau of Standards, Washington, D. C.; B. J. Hulse, Chamber of Commerce, Los Angeles, California; Dr. J. B. Johnston, dean, College of Science, University of Minnesota; Dr. David Starr Jordan, representing Stanford University; Eric Jordan, Stanford University; Dr. Charles L. Marlatt, chairman Federal Horticultural Board, Washington, D. C.; Dr. Francisco Maguel, Mexico City, representing the Republic of Mexico; Dr. E. D. Merrill, dean, College of Agriculture, University of California, representing Philippine government; Dr. Shirley P. Miller, department of anatomy, University of Minnesota; Dr. Frederick C. Newcombe, emeritus professor of botany, University of Michigan; Dr. Herbert Osborn, research professor of zoology, Ohio State University, Columbus, Ohio; Hon. W. H. H. Piatt, Kansas City, representing American Bar Association; Dr. James B. Pollock, associate professor of botany, University of Michigan; Roy R. Reppert, entomologist, Extension Service, Texas; Dr. Hiram Newton Savage, civil engineer, Berkeley, California; Dr. William A. Setchell, professor of botany, University of California; Professor Josephine E. Tilden, professor of botany, University of Minnesota, and head of the University of Minnesota Pacific Expedition; Dr. Koliang Yih, Chinese consul general, San Francisco, and Ralph N. Van Zwaluwenburg, United Sugar Company, Los Machis, Sinaloa, Mexico.

Dr. L. O. Howard, chief of the Bureau of Entomology, Washington, D. C., was permanent chairman of the conference; Dr. Charles L. Marlatt, chairman of the section on plant quarantine, plant entomology and plant pathology; Dr. Hamilton P. Agee, director of the Hawaiian Sugar Planters' Experiment Station, chairman of the section on sugar industry; Dr. L. A. Henke, professor of agriculture, University of Hawaii, chairman section on animal husbandry; Dr. P. J. S. Cramer, director experiment station, department of agriculture, Netherlands East Indies, chairman section on crop production and improvement;

Dr. Carl L. Alsberg, director Food Research Institute, Stanford University, chairman section on food transportation and distribution; Dr. R. Masujima, member of the Japan Bar Association, chairman section on international law and agreement, and Dr. Barton Warren Evermann, chairman of the section on fisheries, marine biology and oceanography.

Honorable Wallace R. Farrington, governor of Hawaii and president of the Pan-Pacific Union, speaking from the throne in Iolani Palace, welcomed the delegates, and Dr. Howard made the response.

All the general sessions were held in the Throne Room, Iolani Palace, in the forenoons, while the afternoons were given over to section meetings.

The conference was divided into several sections, among which some of the more important were those on sugar industry; fisheries, marine biology and oceanography; plant quarantine; plant entomology and plant pathology; animal husbandry; food-crop production and improvement; forestry in relation to agriculture; food transportation and distribution; and international law and agreements.

The problems considered by the conference were the big problems of food production, proper utilization and conservation, and they were considered in a broad way; the international viewpoint was constantly to the fore and the problems were discussed in their international relations. Basic principles relating to soil management, crop production, animal husbandry, the fisheries, care of crop products, transportation and distribution, insect-pest control, quarantine, etc., were presented and discussed in their world application, rather than those of merely local interest.

It is not difficult to see that a conference of nearly 150 representative men, experts in their various lines, gathered together from so many different countries, discussing before formal meetings and in informal meetings daily for a period of two weeks, these big food problems, could not fail to contribute greatly to our knowledge of these problems and to an understanding of the methods for their solution.

The meetings were intensely interesting from the very beginning to the last. Every delegate regarded the conference as one dealing with problems of world importance and demanding the most serious thought and treatment. That much good will come from the conference is certain.

The most important conclusions and agreements reached by the conference are set forth in a series of 33 resolutions adopted. Only a few may be mentioned: One calling for an international treaty for the protection and conservation of the fishery resources of the Pacific, particularly fur seals, sea otters, whales and other marine mammals; another for the protection of marine turtles; another to prevent pollution of the sea and coastal waters by oil tankers and other vessels, and a fourth recommending the formation of an international commission for the study of the physics, chemistry and biology of the North Pacific.

Other resolutions were adopted urging cooperative study of the insect pests of sugar cane, the problems of soil management and crop production, adoption of uniform and proper quarantine regulations and the appointment of an international crop protection board.

An account of the Food Conservation Conference would not be complete without mention of Alexander Hume Ford, the organizer and director of the Pan-Pacific Union. A few years ago Mr. Ford went from the States to Honolulu, as a newspaper man and writer. Soon after arriving at the "Cross-roads of the Pacific" he began to grasp the momentous importance of the problems of the Pacific. He conceived the idea that those problems could be solved only through an understanding of their scientific and commercial relations to *all* the countries bordering on the Pacific, and mutual understanding of the people of those countries. Mutual understandings among nations, as among individuals, are difficult if not impossible unless they know each other. Mr. Ford believed that, if the countries bordering on the Pacific could come to know each other, their international disputes and misunderstandings would largely disappear. So he organized all those countries into the Pan-Pacific Union, which at once began to hold conferences or congresses of various kinds. Any group of men who wish to get together to discuss important problems relating to the Pacific area, by making their wishes known to the Pan-Pacific Union, can have a conference called, and the Union will help by inviting delegates as requested, by arranging the details of the meeting, raising money to defray expenses and in any other proper way.

Several such conferences have already been held, including a scientific conference, an educational conference, a newspaper conference, a commercial conference and a food conservation conference.

The Pan-Pacific Union is probably the greatest force in the world to-day in promoting mutual understanding and good will among the countries of the Pacific area.

And Alexander Hume Ford has been the promoter, the moving spirit, the money-getter, the live wire, the man of vision, in all these conferences.

Barton Warren Evermann
California Academy of Sciences

THE FAILURE OF THE PRINCIPLE OF PRIORITY TO SECURE UNIFORMITY AND STABILITY IN BOTANICAL NOMENCLATURE

The priority of publication principle was adopted with the idea that it would furnish a simple and satisfactory basis for determining which of the various

synonyms that have been applied to most species should be used as a permanent binomial for each species, and at the same time give due credit to the author who first described and named the plant.

The great protagonist of the priority principle, Alphonse de Candolle, began to advocate and apply this rule about 75 years ago, and in 1867 it was adopted by the International Botanical Congress at Paris and has been, with some slight reservations, a part of all subsequent botanical codes.

All human activities, scientific and otherwise, are in the nature of experiments. After having carried on an experiment for a considerable period, it would seem desirable to summarize and evaluate the results obtained. It therefore may be worth while to note the results of 57 years of effort in the application of the principle of priority as a means of securing uniformity and stability in the use of plant names.

It may be appropriate to state briefly what should be reasonably expected from the application of the priority principle and why it has failed. A satisfactory plan should secure for us generic and specific names for plants which would be uniform throughout the world and stable; that is, the same name would always be applied to the same plant and this name would not be subject to change. It is very evident that this end has not been attained in any general way. There are various reasons why these efforts have not been successful and why there is little hope of success according to this plan.

If we examine and compare recent floras of different parts of the world or of different countries, it will easily be seen how far we still are from the desired end, even among the flowering plants where the principle has been applied longest and where the difficulties are least.

The fact that taxonomists after so many efforts have failed to come to any general agreement in regard to a code and that the adherents to different codes do not arrive at the same results in the application of their own rules appears to be rather strong evidence that something is wrong.

Fortunately or unfortunately, according to your point of view, the day of imperial edicts is about past and though organizations of scientists may pass "laws" or make rules they have no power to enforce them other than an appeal to reason and persuasion. The original Paris code recognized this fact when it stated that "rules should be so plain and so convincing that every one would be disposed to accept them." Many botanists and users of Latin names of plants have never been sufficiently convinced of the reasonableness or practicability of the various codes to approve and adopt the changes required, and if they should do so it would not give stability to the names, for continual changes would be necessary as older names were discovered, and thus much valuable time would have to be wasted in learning new names which should be spent in increasing our knowledge of the plants themselves. In mycology, for example, it would require a totally different application or rejection of many of our most common, best known and well-established names.

A few examples may be cited to show the sort of changes which would be required on a basis of priority of publication to the fungi. Hysterium, now applied to a large and well-known group, would be applied to the small genus of Discomycetes, now called Clithris. The name Valsa, instead of being applied to the present large group of species, would supplant the present name Xylaria. The familiar name Daldinia would be displaced by Perisphaeria and the name Phoma,[1] instead of being applied to the small pycnidial forms, as at present, would supplant the name Hypospila for a small group of Pyrenomycetes. The well-known generic name Hypocrea would become Corynesphaera. These are only a few samples of the new applications and the strange names which would have to be learned and used according to this rule as interpreted under the American code. Under the Vienna-Brussels code, with its various dates as starting points for different groups of fungi, the results would be very different and would vary according to the person applying them and his interpretation of the rules. Such names, after all, in the present state of our knowledge would only be "pro tem," as older ones might be found at any time or different interpretations of their application made by later taxonomists.

The principle of priority was supposed to have the particular merit of being easy of application and of producing uniform results. Experience has shown the fallacy of this idea. In applying the rule one immediately becomes involved in questions regarding the actual dates of publication of various books and periodicals and also with questions of validity of publication, and many others which continually arise. These practical difficulties have made it necessary to extend and modify the codes until they have become so long and complicated that our English friends say,[2] "The average botanist who is not an expert in nomenclature finds it difficult to interpret them correctly." They then go on to cite cases in which even the experts fail to agree. On account of these and similar

[1] Shear, C. L., "Phoma: A sample of mycological nomenclature and classification." *Mycologia* 15: 174–182, Jy. 1923.

[2] Britten, James, Ramsbottom J., Sprague, T. A., Wakefield, E. M., Wilmott, A. J. Sub-committee on nomenclature. Imperial botanical conference. Interim report on nomenclature. *Journ. Bot.*, 62: 79–81. March, 1924.

difficulties the zoologists have found it necessary to appoint a committee of experts to decide differences of opinion among the taxonomists as to the application of their rules and the choice of names to be adopted.

There is still no general agreement as to the date to be taken as a starting point in determining priority for the lower plants. There is also no general agreement as to what authors and publications shall be recognized nor exactly what constitutes valid publication. Of course when it comes to questions of synonymy there always will be more or less difference of opinion among specialists, and this can not be entirely avoided.

It is generally understood that the chief purpose of botanical names is to make it possible for all who use binomial names for plants throughout the world to designate particular genera and species conveniently and accurately and in as uniform a manner as possible. It should be recognized clearly that botanical names are no longer primarily for the specialist in taxonomy or the purely systematic botanist. There are large and increasing numbers of horticulturists, pathologists, general botanists and many specialists in plant research who find it necessary to use technical names of flowering plants and fungi. For all such users of plant names, the requirements are primarily practical and utilitarian. They can not be expected to continue to discard names which have been in use for a long time and which to them have a very definite application.

The idea that we are obligated to restore old names as a matter of justice to the early botanists is rather sentimental than ethical. Whatever is best for the benefit and progress of science and humanity is the primary consideration. To perpetuate an author's mistakes and failures, as is frequently the case in taking up old names, is no credit to the author and chiefly a source of trouble to us. The substitution of an obsolete generic or specific name for one in general use, unless for some more important reason than mere priority of publication, serves no sufficiently useful purpose to justify the inconvenience and trouble caused by the change.

The proposal to abandon the resurrection of obsolete names does not mean that we should neglect the history of mycology or the determination of synonyms, but that the current use and application of names should not depend upon such investigations, any more than that our present English vocabulary should be changed on account of the discoveries of philologists and the many obsolete words substituted for those now in common use. Philology is an interesting and valuable study, but no one has seriously attempted to change current usage of English on account of the older synonyms discovered.

A knowledge of the origin and history of binomials and their application and synonymy is interesting and important from an historical standpoint, showing the stages and modes of development of our knowledge of plants and their relationships and modes of treatment, as well as the development and workings of the minds of the various taxonomists. There seems to be no good reason, however, why we should keep changing the names of our common plants in order to reflect increases in our knowledge of the history of taxonomy and nomenclature and the synonymy of plant names.

So far as mycology is concerned the stupendous amount of labor involved and the insurmountable difficulties to be overcome make it impracticable and frequently impossible to determine with certainty the application of the vast number of fungus names to be found in systematic mycology and unless mycologists become more numerous and devote much more attention to the determination of the old species, it will be centuries before we can hope to have the last word said regarding the synonymy of the fungi and the oldest name located and adopted.

It is seen then that one of the principal reasons why stability of fungus names can not be attained for centuries at least, even though perfect agreement should be reached in regard to carrying out the plan, is the practical difficulty of labor, skill and time involved in determining the exact identity and synonymy of the vast number of names of genera and species which have been proposed; many of which have been very imperfectly described and have not been represented by any type or authentic specimens upon which satisfactory identifications can be based.

In the case of the fungi also the difficulties in determining with any reasonable degree of certainty just what organisms the older and also many of the more recent mycologists had before them when they prepared their original descriptions are so great as to be practically impossible in a great number of instances. Still there is usually somebody who will hazard a guess and attempt a change of names on that basis.

Since the writer has been personally interested in nomenclatorial questions for the past thirty years his present position and the reasons therefor may perhaps be worth stating. After much study and many attempts to apply the priority principle to the nomenclature of the fungi, we have finally been driven to the conclusion that even with the general adoption of various improvements, especially the type method of fixing the application of names, it will still be impossible to secure a reasonably uniform or stable nomenclature on that basis.

Until recently we have labored under the delusion that by access to the herbaria of the old mycologists and a study of their type specimens most of the questions of specific identity could be settled. Consider-

ble experience, however, in the study of the older ollections as well as those of recent mycologists in ll the large herbaria in Europe and America has onvinced me that in a great number of cases no cer- in determination can be made as to what particular lant the authors originally applied their names. lost of the old species are not represented by types the true sense of the term, that is, in most cases it impossible to say that any particular specimen, hich may be in an author's herbarium or may have een labelled by him, is the particular one upon which e based his original description. Where such speci- ens do occur they are frequently too fragmentary too poor for certain identification, and the time nd labor consumed in attempting to find the type nd determine it is in most cases not justified by the esults to be obtained. The present application of any of the older names is based on tradition handed own from one mycologist to another.

If we are not to have stable names for our fungi ntil the possibility of finding older synonyms has een exhausted there will be a more or less continuous hange of names for several hundred years to come, ven though a considerably increased number of sys- ematic mycologists undertake the work. Synonymy s important and should eventually be determined so ar as practicable, but there is no justification for ex- pending the time and energy required in discarding old names and learning new ones every time older ynonyms are unearthed.

These considerations, taken in connection with the fact that there will always be, as now, more or less difference of opinion among mycologists as to the identity and validity of many of the older species, as may be used to determine, in case of synonyms, which shall be permanently adopted. It will no doubt be asserted that usage is too uncertain and indefinite to be practicable. We believe, however, that it can be placed upon a practical working basis and thus re- lieve us of the necessity of the more or less continu- ous change of names required by the priority rule.

Of course there is nothing new in this proposition. We simply wish to urge that it be recognized as a valid method of fixing plant names whenever possible and practical provision made for its adoption and ap- plication. The list of "Nomena Conservanda" adopted by the Botanical Congress at Vienna in 1905 was a partial abandonment of the priority rule and a recog- nition of the desirability, if not necessity, of accepting usage in some cases. Unfortunately, however, some of the names in that list were chosen from the stand- point of national or personal rather than general usage. Usage should be interpreted and adopted on an international basis.

A practical and, I believe, satisfactory method of carrying out the plan would be to have an interna- tional commission of expert taxonomists in different groups of plants prepare a list of the genera and species which should, on the basis of general usage, as found in the chief systematic literature, be adopted. For this purpose only works in the English, French, German and Latin languages would need to be con- sulted.

In order to assure certainty and stability in the use of the names adopted under any plan, a type species must be assigned for each genus and type specimens cited for each species.

Perhaps the most convincing proof of the failure of the priority principle to meet the requirements of the people who have most use for binomials is the fact that the principal users of flowering plant names, horticulturists, florists, nurserymen and others, have recently prepared and adopted a list of "standardized plant names."[3] A glance at many of the binomials adopted will indicate that they were not chosen be- cause of priority of publication. The primary pur- pose of the list is said to be convenience and stability in the use of names in the horticultural trades. To accomplish this purpose a name for each plant has been more or less arbitrarily selected. While it is not specifically stated that general usage has played an important part in the choice of the names, the list shows many remarkable coincidences in this respect.

If these names are to be adopted by all practical and professional horticulturists, florists, nurserymen and pharmacists, as is indicated by the endorsement of their national organizations, the professional tax- onomists will find little use for any new or old names which they attempt to substitute or reinstate for those in this list. Why not, then, frankly recognize the in- evitableness of the situation and adopt these names and also proceed to complete the list for all wild as well as cultivated plants, and at the same time try to persuade other nations to do likewise.

There is one thing still necessary to make this list or any other meet the needs of scientific taxonomy as well as practical horticulture. That is, the designa- tion of a particular species as the type of each genus and a specimen or specimens as type of each species and variety, in order that any doubt or question which may arise regarding the exact application of the names may be settled by comparison and study of typical specimens of the plants themselves.

Since the chief users of flowering plant names have found it necessary to abandon the priority principle and arbitrarily adopt names, how can mycologists and pathologists ever hope for uniformity and stabil- ity of the names of fungi on that basis? The diffi- culties in the way of determining with certainty the

[3] "Standardized Plant Names." A catalogue of ap- proved scientific and common names of plants in Amer- ican Commerce. American Joint Committee of Horti- cultural Nomenclature, pp. 1–546, Salem, Mass., 1923.

identity and synonymy of the nearly one hundred thousand so-called species of fungi in mycological literature are insuperable, as has been found by actual experience in studying a few genera, even with all the library and herbarium facilities of America and Europe available.

In order to facilitate the preparation of a list on a basis of usage it may be found desirable to omit from consideration under this plan names of less than 25 years standing, as such names could not perhaps in most cases be regarded as established by usage. As there is considerable dissatisfaction with present codes and their operation even among their adherents—as is evidenced by recent proposals in America and also by the report of the English committee cited—we hope careful consideration may be given to the usage plan.

This plan has the great merit of relieving us of the necessity of abandoning many of the names with which we have long been familiar and learning new and strange names in their place. This is a matter of great practical importance with most users of plant names and has been the source of much of their opposition to the various efforts to reform nomenclature. A well-prepared plan of this kind would probably receive the approval of the majority of botanists who are not particularly interested in taxonomy but still need to use plant names.

The selection of names for all plants on the basis of usage involves no difficulties other than those already overcome by the committee which prepared the list of standardized names mentioned. The zoologists have found it necessary to establish a commission to decide mooted questions regarding the choice of names under their code which is founded on the principle of priority, and a commission of expert plant taxonomists should find no greater difficulties in determining the choice of plant names on the basis of current usage.

As an example of the result of following usage as compared with priority among the fungi we may cite the genus Daldinia, a common and conspicuous Pyrenomycete. This generic name was applied by Cesati and de Notaris in 1863, and two species included *D. concentrica* and *D. vernicosa*. These are regarded as forms of one species by some mycologists. Fortunately, the priority rule has not yet been applied to the majority of fungus names and the name Daldinia has been generally used for these plants by the mycologists of the world ever since it was proposed. However, there are already known three other generic names which had previously been applied to this species. Perisphaeria, Roussel, 1808, and Peripherostoma, S. F. Gray, 1821, are typonyms, being based upon the same species as Daldinia. The third, Stromatosphaeria, Greville, 1824, included 19 species of which the first was *S. concentrica* and would therefore, according to the first species method, be taken as the type of the genus. What we propose is to accept Daldinia as the only valid name for this genus with the type species, *D. concentrica* Bolt., fixed and unchangeable. As to the specific name, *concentrica*, applied by Bolton in 1791, three other specific names of the fungus are already known which may claim priority of publication. These are *atrum* (*Lycoperdon atrum* Schaeffer, 1770), *tuberosa* (*Valsa tuberosa* Scopoli, 1772) and *tunicata* (*Sphaeria tunicata* Tode, 1791). On the priority basis the specific name would be *atrum*. We propose, however, to adopt the name *concentrica* because of general usage. As no original specimen of Bolton is known, a type specimen should be arbitrarily chosen. Cesati and de Notaris cite several specimens in connection with their description of the genus and the first of these might very properly be regarded as type of the species for future purposes. The specimen cited is Erb. Critt. Ital., No. 642. This set of exsiccati is found in the principal large herbaria, and typical specimens are therefore much more accessible to mycologists than the types of most authors.

As a reconsideration and modification of botanical codes is under discussion now, we would suggest that a more general and distinct recognition of usage be provided for in any revision that may be made.

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THE QUANTUM PUZZLE AND TIME

THE essential feature of the quantum theory is the postulate which restricts any periodic motion of an atom or molecule to a discrete series of allowed states of motion with wide gaps between which are not allowed. Stated in ordinary mechanical terms the quantum postulate may be exemplified as follows:

(1) *Simple to and fro vibration*: Consider a material particle of mass m, bound by a spring, and oscillating to and fro so that its distance q from its equilibrium position is

$$q = A \sin \omega t \qquad \text{(i)}$$

where A and ω are constants and t is elapsed time. Let p be the momentum $\left(= m \frac{dq}{dt}\right)$ of the particle. Then

$$p = \omega m A \cos \omega t \qquad \text{(ii)}$$

and if we eliminate t from (i) and (ii) we get

$$\frac{A^2}{q^2} + \frac{p^2}{\omega^2 m^2 A^2} = 1 \qquad \text{(iii)}$$

This is the equation of an ellipse (if p and q are thought of as rectangular coordinates). The area of this ellipse is

$$\int p.dq = \pi \omega m A^2,$$

and because $p.dq$ is a quantity of the same nature as Planck's constant h the idea has arisen that the area of the pq-ellipse might be equal in general to an integral multiple of Planck's constant, or

$$\pi\omega m A^2 = nh \qquad \text{(iv)}$$

where n is an integer. This equation expresses Bohr's quantum postulate as applied to simple to and fro vibration, and the reader must not expect to know the "why" of this postulate, because no one knows the "why" of it. We deliberately and arbitrarily put $\pi\omega m A^2$ equal to nh, that is all there is to it—except results of the most remarkable kind; and when we put $\pi\omega m A^2$ equal to nh we are said to *quantize* the motion.

Solving equation for A we get

$$A = \sqrt{n}\ \sqrt{h/\pi\omega m} \qquad \text{(v)}$$

and the restriction which equation (iv) places on the simple to and fro motion of equation (i) is that the amplitude A of the motion can not have any value whatever but only a discrete series of values which are proportional to the square roots of the successive integers n = 1, 2, 3, 4, etc. This conclusion is absurd from the ordinary mechanical point of view because it means, for example, that a pendulum bob can not oscillate with any amplitude whatever but only with amplitudes which form a discrete series as expressed by equation (v).

(2) *Simple rotation*: When applied to simple rotation Bohr's postulate restricts the speed of rotation of a given body to a discrete series of speeds for which the angular momentum of the rotating body is an integral multiple of $h/2\pi$, which means that the only possible speeds in revolutions per second are those which are integral multiples of $h/4\pi^2K$, where K is the moment of inertia of the body.

This conclusion is absurd from the ordinary mechanical point of view because it means, for example, that a grindstone can not have any speed whatever, but that all possible speeds must constitute a discrete series so that if a grindstone were speeded up it would have to increase its speed by sudden jumps!

These sudden jumps in speed evidently mean discontinuity; and, in general, Bohr's postulate means discontinuity of time or discontinuity of space, or both. It seems strange, therefore, that we should take Bohr's postulate seriously, considering that the postulate is merely a "happy thought" of Bohr's which nobody understands (Bohr himself does not pretend to understand it) and considering that the postulate leads to results which are absurd from the ordinary mechanical point of view. We do take Bohr's postulate seriously, however, because it has led to a theory of line spectra which is in extremely exact agreement with nearly all the known facts of spectrum analysis, to say nothing of several other highly important applications of the Bohr and Planck quantum postulates. On the other hand, the apparent absurdity of the Bohr postulate from the ordinary mechanical point of view can not be demonstrated experimentally, that is to say, the discrete series of allowed states of motion of a pendulum, for example, are so extremely close together that the discrete series is indistinguishable experimentally from a continuous series.

We do an injustice to the remarkable ingenuity of Bohr when we speak of his postulate as a mere "happy thought." It would be much nearer the truth to say that Planck was constrained to his original quantum postulate by a keen appreciation of the experimental facts of heat radiation and that Bohr was constrained to his quantum postulate by his keen appreciation of the experimental facts concerning line spectra. The quantum postulates (Planck's and Bohr's) are perhaps the most ingenious contrivances ever evolved from the contemplation of experimental facts in physics.

It is not the purpose of this note to set forth even the simpler aspects of Bohr's quantum theory of line spectra but rather to point out that our notion or intuition of time seems to become meaningless in connection with quantized motion.

It is to be noted that the time t is at least formally eliminated from equations (i) and (ii) to give equation (iii), and to describe the state of a simple oscillator on the basis of equation (iii) is to make use of the momentum p as a basic idea instead of time. Similarly, angular momentum becomes basic in the quantum-theory description of the state of a simple rotor. Of course momentum, as ordinarily thought of, involves the idea of velocity and therefore also the idea of time; but if we postulate momentum as a basic idea and if we could refrain from "thinking" of the state of an oscillator or rotor as "motion" we would have time-free descriptions of the states of an oscillator or rotor. This statement should call to the reader's mind the central paradox of Bohr's theory, namely, that although the Bohr states of the hydrogen atom are described as orbital motions when we wish to *think* about these states, yet such descriptions seem to be essentially artificial, and the motion, as we think of it, really non-existent. The difficulty is that time is to us an essential mode of thought, whereas there is no actual physical condition or thing bound up in a Bohr state which corresponds to time as a fact. This is, of course, a dilemma; any resolution of this dilemma, however consistent and logical, will be necessarily unthinkable; and, before proceeding to discuss an unthinkable resolution of this dilemma, let me paraphrase a statement of Bohr's.

We are not at all justified in assuming that our human ways of thinking about things we see and handle are

suitable ways of thinking of atomic action. Our human ways of thinking are bound up inextricably with our intuitions of space and time, and atomic action may not take place in what we call space and time.

This is the dilemma.

What fact or condition in nature is it that comes nearest to our intuition of time? or is most closely in accord with our feeling of an inevitable forward movement which we call time? What fact or condition in nature is it that most certainly justifies our idea that something or other in general in this world of ours always does go forward and never does nor ever can go backwards? What observed condition or thing is it that embodies as a fact the essential quality of intuitive time? The answer, as it seems to me, is evident. It is what in thermodynamics we call the irreversibility of natural processes. This condition or fact underlies the second law of thermodynamics, and the law of increase of entropy is the most completely non-anthropomorphic generalization that grows out of it. The law of increase of entropy and our intuition of time unquestionably grow out of the same condition in nature, but entropy and time as physical quantities differ[1] from each other very greatly because of our artificial methods of measuring them.

Imagine a purely mechanical system, a system not involving any irreversible action. After sufficient "time" such a system will certainly come back to its initial condition, and everything will be as at first; except that "time" has elapsed. What does this mean? Where has "time" elapsed? What is this elapsed "time" which makes a difference between the initial and final states of our system which initial and final states are exactly alike? The difficulty is that someone is supposed to look at or contemplate our supposed purely mechanical system. This someone is certainly not a purely mechanical thing, and therefore the totality of things under consideration is not purely mechanical in the sense of being entirely free from irreversible action. The moment you look at or contemplate a perfectly mechanical system the time idea or the time intuition becomes essential and real.

However, if time is an objective condition and if it is bound up with thermodynamic irreversibility it can not have a universal and uniform forward flow, it must go forwards irregularly and unequally as resident in different things, and it can not go forwards at all as resident in a purely mechanical thing.

[1] The simplest argument which leads to the notion of entropy makes increase of entropy proportional to lapse of time. See Nichols and Franklin's "Elements of Physics," Vol. II (1894), or see Franklin and MacNutt's "Heat" (1924), pp. 128–140.

A purely mechanical world would certainly b timeless. The introduction of a mere observer woul introduce time as a fact, this fact-time would b wholly bound up in the observer as a non-mechanica thing, and this fact-time would be irregular if th observer is of the ordinary sleeping and waking kind! Furthermore, the introduction of a thinke would introduce time as a uniform forward blow time as an intuition, time as a mode of thought.

About all we can say of the steady states of th hydrogen atom as conceived by Bohr is that they are *steady states,* states which involve no irreversibl action, no absorption or emission of radiation, no change of any kind. Now a purely mechanical system is an unrealizable ideal because radiation exists everywhere and no mechanical system can be so isolated as to be free from irreversible action. But a hydrogen atom in a steady state is immune to radiation and probably immune to electron bombardment when certain threshold conditions are not over passed so that a hydrogen system in a steady state is perhaps entirely free from irreversible action, a kind of super-mechanical system, as it were. The idea of lapse of time would therefore seem to be an absurdity when applied to a hydrogen atom in a steady state, although we must necessarily make use of the idea of time in describing a Bohr steady state as "motion."

In the Bohr theory the atom is supposed to jump from one quantized state to another of lesser energy, and the energy lost is supposed to be radiated in accordance with Planck's postulate which is that

$$h\nu = \Delta W \qquad (v)$$

where h is Planck's constant, ΔW is the energy lost by the atom, and ν is the frequency of the emitted radiation. But what happens "while" the jump is taking place, if time does not go forwards at all during a steady state, and does go forwards discontinuously or with a jump "during" the transition from state to state? This is the kind of attempt at thinking that one is repeatedly making in considering the Bohr theory which seems really to demand the non-existence of time!

Non-existence of time; suppose such to be the case. But the emitted radiation has a definite measurable wave-length or frequency, and, surely, a frequency necessarily involves time! This is the way we think of a frequency, to be sure, and two things may be said in criticism of the way in which we think of such a thing; but before saying these things let me suggest (and I admit that my suggestion is extremely vague) that the time element which enters to fix the frequency of the emitted radiation may be bound up with an entropy change which is associated with the transition of the atom from state to state. The Bohr jumps are now thought to be reversible because radia-

tion seems sometimes to be absorbed by an atom and cause a jump to perform itself backwards; but I certainly believe that some essential element of irreversibility must eventually be discovered in atomic action, because the older kinetic theory as developed statistically leaves irreversibility essentially unexplained.

Where is the fallacy of the time-idea in our notion of frequency? Look at a swinging pendulum and count its movements in a measured time. This you can do, and you thus find the frequency. Similarly, let me ask you to look at a hydrogen atom in a steady state and count the number of revolutions of the electron in a measured time. This sounds logical enough, but the atom in a steady state does not radiate, and there may be a fundamental fallacy in even imagining that one might look at such an atom. As we see things, so we think of them, and our see-thinking may be absurd when carried over to things which are essentially un-seeable; essentially un-seeable, mind you, not merely too small to see.

Or suppose you look at the "kinks" (waves?) of the emitted radiation as they come out of an atom when it jumps from Bohr state to Bohr state and count the number of kinks in a measured time. This also sounds logical enough, but after the jump the atom is in a steady state and no time elapses in the atom, and once a radiation is established the radiation is itself a steady state and no lapse of time can reside in the radiation. The idea of frequency would seem to be applicable to radiation only when the radiation has stretched out in our large-scale world and has come into relation with large-scale things where time is a legitimate idea. Our intuitive notion of time, as it seems to me, is tenable only in large-scale physics, or macro-physics, but untenable in small-scale physics, or micro-physics.

My suggestion that time does not exist in a purely mechanical system refers only to what we think of as continuous time or time flow, it is not intended to deny the reality of coincidences in time.

All, or nearly all, of our time and space experience grows out of coincidences in time and coincidences in space. Even the measurement of a length depends wholly on coincidence observations. A yard stick is fitted to the successive parts of the distance to be measured and each such "congruence operation" involves two coincidence observations, one at each end of the yard stick. The measurement of a time interval also consists almost wholly of coincidence observations. Furthermore, the vast complex of everyday life in its sense aspects involves little else than coincidence observations. But even men of the street are accustomed to express time and space experiences in terms of quantitative ideas, and this purely mental habit has come about, no doubt, because to express these experiences in purely experimental terms would be extremely tedious. Our quantitative notion of time as a continuum of duration and our quantitative notion of space as a continuum of extension come wholly, it would seem, from our mathematical predilections. No one, as it seems to me, could maintain that these quantitative notions of space and time are essential in the most complete sense-orientation of a man in any situation in life; but it would be impracticably and even unintelligibly tedious to talk about space and time experiences without using quantitative ideas. Herein lies the reason why any point of view which is contrary to our ideas of continuous space and continuous time is unwelcome. Our mathematical bias, note that I now use a stronger word than predilection, is wholly in favor of continuous mathematics and wholly opposed to discontinuous mathematics, and the reason of this bias is evident to those who have attempted to develop a discrete or discontinuous mathematics!

I am convinced that the qualifications of our ordinary notion of time which I have suggested[2] contain nothing whatever that is inconsistent with experience, and, however absurd these qualifications may seem to be, it must be admitted, as it seems to me, that the quantum puzzle becomes more clearly defined as a puzzle in terms of these qualifications.

If the Planck and Bohr postulates contain some new thing that is essential for the description of atomic action, and no one who is familiar with the amazing developments that have been made on the basis of these postulates can doubt that they do contain something new which is essential, then we must expect soon to see a more wonderful transformation of our conceptions of the physical world, a vastly more wonderful transformation, than that which has resulted from the relativity theory.

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SCIENTIFIC EVENTS

EXHIBIT OF THE ROYAL SOCIETY AT THE BRITISH EMPIRE EXPOSITION[1]

ONE of the most fascinating and impressive sections of the British Empire Exhibition, though admittedly one that is essentially specialist, is the exhibition of pure science arranged by the Royal Society. In connection therewith the Royal Society has now issued a handbook which is a great deal more than a mere catalogue, and is, indeed, a volume which might well be secured by students of pure science and amateurs,

[2] This suggestion was first made in a paper on "Entropy and time" in the *Physical Review*, Vol. XXX, pp. 766–775, June, 1910.

[1] From the London *Times*.

and preserved by them as a text-book long after the exhibition has been closed.

As a foreword to the handbook shows, this exhibit was organized, at the request of the government and out of funds provided through the Department of Overseas Trade, by the Royal Society. The council of that body appointed a British Empire Exhibition Committee, under the chairmanship of Sir Richard Glazebrook, to carry out the task. In the majority of cases the exhibits are shown by the scientific men actually engaged in the work, supplemented by instruments lent by some of the leading firms of scientific instrument makers. Arrangements have been made, wherever possible, to demonstrate the use of the instruments and apparatus in the methods in which they have been employed by the authors whose work is illustrated. Demonstration benches, fitted with gas, water and electricity, are provided, and a staff of scientific assistants is in attendance. Owing to the limited space available it has been necessary to arrange for the rotation of certain of the exhibits, particularly those shown on the demonstration benches.

The handbook is arranged in two parts. The first is a series of articles by well-known authors, intended to give some indication of the state of science at the time of the opening of the exhibition, while the second is a descriptive catalogue. In certain cases the Royal Society has been instrumental in arranging exhibits which are shown in the scientific section of the chemical hall in the palace of industry. Descriptions of these exhibits are given in the catalogue, but the fact that they are shown elsewhere is indicated. The following is a list of the articles in the handbook, together with the names of the contributors:

"The genesis of the Royal Society," Dr. Irvine Masson; "The electron," Sir Joseph Thomson, O.M.; "X-rays and crystal structure," Sir William Bragg; "Electricity and matter," Sir Ernest Rutherford; "Atoms and isotopes," Dr. F. W. Aston; "Verification of the theory of relativity," Sir Frank Dyson; "The interior of a star," Professor A. S. Eddington; "The origins of wireless," Sir Richard Glazebrook; "Thermionic valves," Professor J. A. Fleming; "The origin of spectra," Professor H. Fowler; "Helium gas and its uses," Professor J. C. McLennan; "The principles of fine measurement," Dr. J. E. Sears; "The circulation of the atmosphere," Sir Napier Shaw; "The water in the atmosphere," Dr. G. C. Simpson; "Weather forecasting," Lieutenant-Colonel E. Gold; "Atmospheric electricity," Dr. C. Chree; "The origin of man," Dr. A. Smith Woodhead; "The circulation of the blood," Professor E. H. Starling; "The biological action of light," Professor D. T. Harris; "Muscular work," Professor A. V. Hill and Professor E. P. Cathcart; "Insect mimicry and the Darwinian theory of natural selection," Professor E. B. Poulton; and "The origin of the seed plants," Dr. D. H. Scott. Sir Richard Glazebrook (physics), Sir Napier Shaw (geophysics), and Mr. Tate Regan (zoology and botany) have written in the descriptive catalogue of exhibits.

FRENCH UNIVERSITY MISSION TO MOROCCO

WITH the purpose of stimulating interest in the French undertakings in Morocco and spreading a true knowledge of the country, the administration of the Protectorate arranged for a French University Mission to visit the country in October, 1923. According to the British *Journal of Geography* the mission was not confined solely to geographers, but numbered among its members geologists, jurists and historians. An entire number of *Annales de Géographie* (May 15, 1924) is given up to an account of the tour, and to articles both by members of the mission and by government officials. From October 9 to 26, a considerable area was covered, partly by motor, partly by varying local means of transport. Landing at Casablanca, the party visited Marrakesh, Rabat, Meknes and Fez, besides other places further from the beaten track, and reembarked at Oran. The first article in the *Annales*, by J. Célérier, gives a detailed account of the country traversed, with particular attention to the physical features and regions and the position of the towns: its geology is detailed separately by J. Savornin. Proofs of the desiccation of a portion of Morocco are advanced by E. de Martonne and others in the course of a morphological study of the Rehamna massif. Here the change in the hydrographic *régime* has been related to deforestation. The present condition of the vegetation of Morocco is detailed by M. Sorre, who, by constructing a provisional vegetation map, has shown its close relation to the rainfall, particularly in the coincidence of the "Mediterranean" area of the Atlantic coast with that of heavy rains. The native population of Morocco is analyzed by MM. A. Bernard and P. Moussard, who correct the impression that it may be divided upon a language basis into Arabs and Berbers, for a great part of the Arab-speaking people are racially Berbers. The distribution of the Berber-speaking population follows very closely the physical relief of the country. As would be expected, the Berbers inhabit the mountains, the Arabs the plateaux and plains, with intermediate bi-lingual areas. As to the French civil population, it appears from a note by G. Jacqueton on "La colonisation français au Maroc," that at present it numbers about 55,000. A census, taken in March, 1921, showed that of the total civil population of 49,000, 41,000 were living in the towns, notably Casablanca and Rabat. After deducting officials, artisans, and business men from the remainder, the number of agricultural colonists and their families would seem to be little more than 3,000. To improve this state

of affairs, the government have initiated a scheme under which, between 1918 and 1923, 449 lots, amounting altogether to 71,496 hectares, have been settled.

THE THIRD PAN-AMERICAN SCIENTIFIC CONGRESS

THE opening of the Third Pan-American Scientific Congress, which was due to take place November 16, has been postponed to December 20. The reason for the adjournment is that the congress, if it met in the second fortnight of November, would clash with a period of intense scholastic activity in the universities of Peru and other countries of America. The organization committee has therefore been led to request that the congress be postponed for a few weeks, and the Peruvian government has fixed December 20 as the date of the inauguration.

Desiring to obtain all possible benefits out of this circumstance, the organization committee has furthermore resolved that the period within which papers can be presented, which expired on October 1 of this year, be extended one month more; said papers may therefore be received up to November 1. As provided under the regulations of the congress, in case an author is unable to send in his work in time, he shall at least forward a summary thereof not exceeding 1,500 words. Such summary must be presented with each work, irrespective of the latter itself being sent in in time. The members of the organization committee are confident that this new adjournment of the opening of the congress will allow many American scholars greater latitude in the presentation of their studies and monographs for the congress.

The "Compañía Peruana de Vapores" (Peruvian S. S. Co.), and the Grace Line have decided to allow a 25 per cent. reduction on its fares to members and adherents to the congress; the Peruvian Corporation has agreed to grant them a 50 per cent. rebate on its railway and Lake Titicaca steamboat fares. Negotiations are under way with other steamship companies for similar facilities.

JOSÉ J. BRAVO,
Secretary General

PROGRESS IN STANDARDIZATION

THE increasing interest and activity in industrial standardization is demonstrated by the new Year Book of the American Engineering Standards Committee. The work of the committee is indicative of the growth of the movement as a whole. One hundred and fifty-two projects have been completed, or are under way, and in these various projects two hundred and thirty-five national organizations, technical, industrial, governmental, are officially cooperating through accredited representatives. The number of the individuals serving under various sectional committees of the different projects is nearly 1,100.

Of the projects which have reached an official status, 31 have to do with civil engineering and the building trades; 25 with mechanical engineering; 15 with electrical engineering; four with automotive subjects; 11 with transport; one with ships and their machinery; 14 with ferrous metals; 15 with non-ferrous metals; 12 with chemical subjects; two with textiles; five with mining; five with the wood industry; one with the paper and pulp industry, and 11 projects with topics of a miscellaneous or general character.

Cooperation in joint activities between Mr. Hoover's division of simplified practice and the American Engineering Standards Committee has steadily increased. In general the work of the committee is concentrated upon standardization projects which involve technical considerations, while the division of simplified practice concentrates upon such eliminations as it is possible to carry out from a consideration of statistical production data alone, or as stated in the book on trade association activities issued by the Department of Commerce, "the layman can proceed successfully with a simplification program, while it would be impossible for him to consider seriously standardization problems by himself."

In order to meet the demands made upon it by industry, and to supply the needs of the various working technical standardization committees, the American Engineering Standards Committee has greatly broadened its information services, and has added an engineer translator to its staff for this purpose. In this way, complete information is made available to sustaining members, trade and technical associations and other inquirers on standardization activities in foreign countries, as well as in the United States.

A new development is the appointment of local representatives of the committee in four important industrial centers. These are: K. F. Treschow, secretary, Engineers Society of Western Pennsylvania, Pittsburgh; J. B. Babcock, executive secretary, Affiliated Societies of Boston; Edgar S. Nethercut, secretary, Western Society of Engineers, Chicago; Professor George S. Wilson, Engineering Experiment Station, University of Washington, Seattle.

One of the most striking developments of the standardization movement is the increasingly important rôle which trade associations are playing in it. More than 140 national trade associations are officially participating in standardization projects under the auspices of the American Engineering Standards Committee. That standardization is a legitimate and constructive activity for associations is everywhere recognized, and explicitly so by a recent decree of the U. S. District Court at Columbus, Ohio.

MEETING OF ELECTROCHEMISTS AT DETROIT

THE next meeting of the American Electrochemical Society will be held at the Hotel Tuller, Detroit,

Michigan, on October 2, 3 and 4. The subjects covered by the program have a wide commercial bearing.

Two sessions will be devoted to the subject of "Corrosion," a subject of interest not only to the electrochemist, but to engineers in every field of activity. Contributions to this subject have been received from all parts of the world and the sessions promise to be well attended.

Detroit is the heart of the automobile industry of this country, and it is very fitting for the society to have at this time an open forum on the topic "Industrial Electric Heating," in which field the automobile industry has made such remarkable strides. Professor C. F. Hirshfeld, of the Detroit Edison Company, is responsible for the program on electric heating. There will also be sessions on refractories for electric furnaces and the physical chemistry of electrodeposition.

Two round table discussions have been arranged, one on "Electric furnace cast iron," in charge of Mr. G. K. Elliott, of the Lunkenheimer Co., Cincinnati, and the other, on "Control methods in electrodeposition," in charge of Professor O. P. Watts, of the University of Wisconsin, and Dr. William Blum, of the Bureau of Standards.

Mr. Alex Dow will address members and guests on Friday evening, his subject being "Central station design and superpower."

Aside from the technical and scientific program, the entertainment committee has made adequate preparations. For Wednesday evening, a "Get-together" dinner at the Eastwood Inn has been arranged. Other entertainment features include a smoker at Hotel Tuller roof garden, automobile trips and a theater party for the ladies, and visits to a number of the large automobile plants.

SCIENTIFIC NOTES AND NEWS

PROFESSOR FREDERICK SODDY, professor of chemistry in the University of Oxford, has been elected a foreign member of the Accademia dei Lincei of Rome.

SIR FREDERICK MILLS, chairman of the Ebbw Vale Steel, Iron and Coal Co., has been elected president of the Iron and Steel Institute of England, to succeed Sir William Ellis, managing director of John Brown and Company, Sheffield; Professor H. le Chatelier, W. H. Hewlett, E. Steer and C. J. Bagley have been elected honorary vice-presidents and Sir Charles Wright, E. W. Harbord and W. R. Lysaght ordinary vice-presidents.

A BAS-RELIEF was unveiled at the Roscoff Biological Station, France, on August 10, in memory of Dr. Yves Delage, who was professor of zoology at Paris and for many years director of the Biological Station.

AT the sixth meeting at Luxembourg, from August 3 to 5, of the International Dental Federation, Dr. Truman W. Brophy, of Chicago, president of the federation, was awarded the Miller memorial prize for important work in connection with dentistry.

DR. J. A. PRESNO, editor of the *Revista de Medicina y Cirugía* of Havana, president of the Academy of Sciences, has been elected corresponding member of the Surgical Society of Paris. The French government has also decorated him as chevalier of the Legion of Honor.

THE council of the National Institute of Agricultural Botany at Cambridge, which is entrusted with the award of the medal struck to commemorate the services of the late Mr. John Snell to potato husbandry, has given the medal for 1923 to Professor H. M. Quanjer, of Wageningen, Holland, for his work on the virus diseases of potatoes.

THE Alvarenga prize has been conferred by the Academy of Sciences at Lisbon on Dr. Vasco Palmeirim for his monograph on "Shock."

DR. PAUL E. HOWE, associate in the department of animal pathology of the Rockefeller Institute at Princeton, N. J., has been appointed biological chemist in the animal husbandry division of the Bureau of Animal Industry, and will have charge of the nutrition investigations in animal husbandry.

F. J. CRIDER, professor of horticulture at the University of Arizona, has resigned to become director of the Boyce Thompson Southwestern Arboretum at Superior.

DR. E. W. WALCH, Dutch physician, who has been placed in charge of malaria control for the island of Java, is visiting the United States.

ERNST J. SCHREINER, from the New York State College of Forestry, Syracuse University, has been secured by the Oxford Paper Company for investigations with *Populus* in which The New York Botanical Garden is cooperating.

THE *Journal* of the American Medical Association states that it is proposed to celebrate the seventy-fifth birthday of Professor Ivan P. Pawlow, the physiologist, on September 21, by issuing a souvenir volume of the *Archives for Biological Sciences*, the official organ of the Institute for Experimental Medicine at Leningrad. The articles for the special number are to be published in the language of the writers. Professor Pawlow has declined any personal official ceremony.

DR. WILLIAM BOWIE, chief of the division of geodesy of the U. S. Coast and Geodetic Survey, and secretary of the American Geophysical Union, sailed from New York on September 9, on the *Roussillon*,

of the French line, for Spain. He will attend, as representative of the United States and of the Coast and Geodetic Survey, the conferences of the International Geodetic and Geophysical Union which will be held at Madrid, from September 24 to October 8. Dr. Bowie is president of the section of geodesy of the International Union.

DR. LOUIS A. BAUER, director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, sailed from New York on September 13, in order to attend the meeting of the International Geodetic and Geophysical Union at Madrid. He expects to return to Washington on October 20.

DR. FRITZ HABER, of Germany, noted for his work on the fixation of nitrates from the air, who is now in the United States to give a lecture at the Franklin Institute Anniversary, will make an official visit to Japan, empowered by President Ebert to present a collection of German scientific books to replace those destroyed in the Imperial Library by the earthquake and fire.

PROFESSOR LUIGI LUGGI, of the University of Genoa, has sailed for New York to represent Italian institutions of learning at the coming celebration of the centenary of the founding of Rensselaer Polytechnic Institute, at Troy, N. Y.

THE Danish Arctic explorer, Lauge Kock, has left Copenhagen for the United States, to accept invitations to lecture before a number of American societies and universities.

DR. J. H. L. CUMPSTON, director-general of health of Australia, is visiting this country under the auspices of the International Health Board.

ROALD AMUNDSEN, Arctic explorer, has filed a voluntary petition of bankruptcy and has definitely cancelled his projected aerial trip to the North Pole.

DR. NELSON H. DARTON, of the United States Geological Survey, has arrived in Mexico City to begin the study of the Cuicuilco ruins in the vicinity of Tlapan, thirty miles from the city.

DR. A. B. STOUT, director of the laboratories of the New York Botanical Garden, spent two weeks during July and August at Presque Isle, Maine, continuing studies on sterilities of potatoes in cooperation with the U. S. Department of Agriculture.

DR. BARTON WARREN EVERMANN, director of the Museum and the Steinhart Aquarium of the California Academy of Sciences; Miss Alice Eastwood, curator of botany in the academy, and Dr. Mary Page Campbell, member of the academy, have returned to San Francisco from Honolulu where they were in attendance at the Pan-Pacific Food Conservation Conference from July 31 to August 14. All were delegates from the California Academy of Sciences, and Dr. Evermann was a delegate also from the Pacific Division of the American Association for the Advancement of Science and from the San Francisco Chamber of Commerce.

JOSEPH MAILLIARD, curator of birds and mammals in the California Academy of Sciences, accompanied by Mr. Jack Malloch as assistant, has gone to northeastern California to continue his studies of the birds and mammals of that region. They expect to remain in the field about two months. Special attention will be given to problems of local distribution.

E. P. VAN DUZEE, curator of entomology in the California Academy of Sciences, has returned from southern Arizona where he and his assistant, J. O. Martin, spent six weeks collecting Hemiptera and other insects. He brought back about 15,000 specimens to enrich the academy collections.

PROFESSOR W. OSTWALD, of the chair of colloid chemistry in relation to biology at the University of Leipzig, has been delivering a course of lectures at the Institute of Applied Chemistry at Barcelona.

PROFESSOR E. VITORIA, director of the Sarria Institute for Chemistry at Barcelona, has arrived in Argentina where he is to deliver a course of lectures at the Buenos Aires and La Plata Universities on chemistry and laboratory methods.

DR. HENRY KRAEMER, formerly professor of pharmacognosy and dean of the College of Pharmacy at the University of Michigan, has died, aged fifty-six years.

DR. GEORGE W. HUBBARD, founder and for forty years head of Meharry Medical College, Nashville, Tennessee, died on August 22.

THE death is announced of Geo. Baptista de Toni, professor of botany in the school of veterinary medicine of the University of Modena, at the age of sixty years. Dr. de Toni was elected a member of the Paris Academy of Sciences last June.

DURING the months of April and May the departments of botany and zoology of the University of the Philippines, Manila, held their first summer session at the temporary Marine Biological Station at Puerto Galera, Mindoro. Twenty-one students, most of them instructors of biology in various colleges and high schools, attended the courses either in botany or zoology under Dr. R. Kienholz or Dr. P. B. Sivickis, respectively.

ON August 29, eight students of zoology from the University of Pittsburgh returned from British Guiana where they had spent the summer months studying ecology under the direction of Professor Alfred Emerson. This was the first organized university

class ever held in the tropical rain-forest and was so successful that other classes will be sent from the University of Pittsburgh in future years. The students spent nearly their entire time at the Tropical Research Station of the New York Zoological Society at Kartabo, British Guiana.

AFTER a four months' leave of absence engaged in investigations on Fanning and Washington Islands, Professor W. B. Herms has returned to active work in the department of entomology and parasitology of the University of California. While on Fanning and Washington Islands certain coconut pests were investigated, mainly the borer, *Diocalandra taitensis* (Guerin), which is responsible for considerable damage on these islands. In addition Professor Herms and his assistant, Mr. Harold Kirby, Jr., fellow in zoology, made a general study of the fauna and flora of both islands, particularly Fanning, which is a typical coral atoll and presents a fertile field for the biologist. Extensive collections of both plants and animals were made for later studies and deposit in the interested museums of the University of California.

THE Goessmann Laboratory of Chemistry at the Massachusetts Agricultural College, in Amherst, will be dedicated on October 3. The speakers will be Dr. C. A. Browne, of the Bureau of Chemistry, U. S. D. A.; Dr. Thorne M. Carpenter, of the Nutrition Laboratory of the Carnegie Institution of Washington, in Cambridge, Mass.; Dr. Frederick Tuckerman, of Amherst, and Dr. J. B. Lindsey, head of the Department of Chemistry.

BY the will of the late Mrs. Henrietta O. Littleton, the American Museum of Natural History receives $100,000.

THE Adelaide correspondent of the London *Times* reports that the congress of the Australasian Association for the Advancement of Science opened on August 25. Large Australian and New Zealand delegations were present, and an important *agenda* occupied the week. Lieutenant-General Sir John Monash, who succeeded Sir George Knibbs, the director of the Institute of Science and Industry, delivered the presidential address on "Power development." He said that Australian investment in electrical transmission had been relatively negligible, and that much research should be done before committing themselves deeply to a more extensive use of present methods. Speaking at the mayor's reception, Sir George Knibbs said that it was well that Australia's spirit of appreciation for science had grown so rapidly, as it was essential to acquire sufficient wealth and population to meet all contingencies. Sir John Monash pleaded for a greater recognition of science by public men, and for larger state grants to scientific institutions.

ACCORDING to the *Journal* of the American Medical Association, the incorporation of the Academy of Medicine of Cleveland has been completed and the secretary of state has issued a charter. The change necessitated the election of a board of directors or trustees by the members who shall hold office for a stated period of years. The new board of directors comprises Drs. Harold Feil, Samuel J. Webster, Edward P. Monaghan, L. Morris, Clyde L. Cummer, Jacob E. Tuckerman, Harold O. Ruh, Frederick J. Wood, Harry V. Paryzek, Lawrence A. Pomeroy, Arthur J. Skeel, Frank S. Gibson, John D. Osmond, Richard Dexter, Harry D. Piercy. The new officers are: president, Jacob E. Tuckerman; vice-president, Edward P. Monaghan; secretary-treasurer, H. V. Paryzek.

THE first survey to be made by the proposed naval research expedition would be devoted to the Gulf of Mexico-Caribbean region under recommendations formulated on August 28, at a meeting of the executive committee of the interdepartmental conference on oceanography, held at the Navy Department. The tentative program lists as the next step "neighboring parts of the North Atlantic," then south through the Panama Canal into the Pacific to the Galapagos Islands. Subsequent work would be carried on in the waters of the North Pacific.

UNIVERSITY AND EDUCATIONAL NOTES

ERNEST GATES, of Yorkshire, England, has promised to provide the sum necessary to complete the endowment of a School of Pathology for Cambridge University. The trustees of the Rockefeller Foundation recently offered the University of Cambridge to provide £100,000 to build a school of pathology, together with the sum of £33,000 towards its endowment, provided the university raised an additional £33,000.

THE University of Paris has accepted a donation of five million francs from M. Biermans and Mme. Laporte for the construction of a dormitory for students from Belgium, Luxembourg and Limbourg.

W. C. NICHOL, lieutenant-governor of British Columbia, has given $18,000 to the University of British Columbia to provide three scholarships of $1,200 each, tenable for five years at French universities, with the object of promoting a better understanding between the British and French races.

DR. MARION TALBOT, professor of household administration and dean of women at the University of Chicago, has given to the university $15,000 to be used as an endowment for the advancement of the education of women.

THE following promotions have been made at the University of Chicago: Dr. William Duncan MacMillan to professor of astronomy; Dr. Adolf C. Noé to associate professor of paleobotany, and Dr. Marion H. Loeb to assistant professor of anatomy.

DR. GEORGE R. BANCROFT, associate professor of physiological chemistry, has been promoted to the rank of full professor and head of the department of physiological chemistry in the School of Medicine of West Virginia University.

DR. FRANK E. RICE, assistant professor of chemistry at Cornell University, has been appointed professor of biochemistry at the North Carolina State College.

THE following additions to the staff of the department of physics of the University of Pittsburgh are announced: professor and head of the department, L. P. Sieg, of the University of Iowa; assistant professors, Richard Hamer, of the University of Wisconsin, and W. St. Peter, of the University of Michigan; instructors, Theodore Hunter, of the University of Iowa; M. H. Trytten, of Luther College, and J. J. Weigle, of the Westinghouse Research Laboratory.

ADJUNCT PROFESSOR P. M. BATCHELDER, of the University of Texas, has been appointed acting assistant professor of mathematics at Brown University for the academic year 1924–1925.

DR. OLIVER H. GAEBLER has been appointed associate in biochemistry in the department of chemistry in the State University of Iowa, and Dr. Earl R. Norris, instructor in the same department.

DR. P. B. SIVICKIS, professor and acting head of the department of zoology, University of the Philippines, was recently appointed permanent head of the department in place of Professor A. L. Day, retired.

DR. FRED M. SMITH, Chicago, has been appointed professor of internal medicine and head of the department of theory and practice of medicine at the State University of Iowa College of Medicine to succeed Dr. Campbell P. Howard, who resigned to accept the professorship of medicine at McGill University Faculty of Medicine, Montreal.

DR. ARTHUR W. M. ELLIS has been appointed to the university chair of medicine at the London Hospital Medical College. Dr. Ellis, during 1909–1910, was resident pathologist of the Lakeside Hospital, Cleveland, and demonstrator of pathology in the Western Reserve University School of Medicine.

DR. S. BRODETSKY, teacher in applied mathematics, at the University of Leeds, has been appointed professor of mathematics.

DISCUSSION AND CORRESPONDENCE

A MATHEMATICAL BLACK SHEEP

THE most noted mathematical black sheep is doubtless H. Cardan (1501–1576) whose name is usually associated with our common formula for the solution of the general cubic equation. In particular, he is often charged with having obtained this formula from Tartaglia under a solemn promise of secrecy and with having then published it in his noted "Ars Magna" (1545), in violation of this promise and without giving due credit to Tartaglia. Fortunately, some of the more recent mathematical historians have come to the conclusion that his actions in this connection are not as reprehensible as earlier writers had supposed. The formula which he obtained from Tartaglia may have been due to an earlier Italian writer named Ferro, and, in fact, this formula is called *Ferro's formula* in one of our best recent histories of elementary mathematics, Tropfke, "Geschichte der Elementar-Mathematik," Volume 3, 1922, page 73, and elsewhere.

In an article entitled "Psicologia dei matematici," published in a recent number of *Scientia*, Volume 35, 1924, page 10, the noted Italian mathematical historian, G. Loria, states that the autobiography of H. Cardan entitled "De vita propria" is of little value as a historical document in view of the fact that its author wisely abstains from replying to the charges made against him. Since the common biographical sketches are largely based on this autobiography many of the charges contained in these sketches have not been established. It seems very fortunate that the blackest sheep among the eminent mathematicians is thus slowly changing color for the better. This will be especially interesting to those who believe that the devotion to mathematical study has a tendency to nobler thinking and the improvement of morals.

In the article to which we referred, G. Loria emphasizes the fact that most of the biographical accounts of mathematicians, especially those relating to the thinkers of antiquity, have little historical value since they are based largely on anecdotes and grandiloquent praises of doubtful authority. This is of considerable interest in view of the fact that most of our general histories of mathematics devote much space to such biographies. From the fact that it is difficult to purge the literature from such obvious biographical errors as the one relating to the supposed welcome given by Regiomontanus to Copernicus, while the latter was in Rome (SCIENCE, Vol. 60, p. 82), it is clear that it is almost hopeless to eliminate the less obvious ones, especially when they relate to the less prominent scientists. Too many mathematical historians have accepted statements which appear plausible and can not be disproved at the present time

instead of restricting themselves to what is based on strong evidence.

UNIVERSITY OF ILLINOIS G. A. MILLER

TRANSMISSION OF COWPEA MOSAIC BY THE BEAN LEAF-BEETLE

OBSERVATIONS on the occurrence of the bean leaf-beetle (*Ceratoma trifurcata* Forst.) indicate that this insect may be responsible for the spread of cowpea mosaic, a little understood but serious disease of cowpeas. This disease, which is now known to be present in Louisiana, Arkansas and Indiana, causes mottling and crinkling of the cowpea leaves. The injury is similar to that found on most other mosaic-affected, dicotyledonous plants, the leaves being greatly distorted and the internodes shortened.

Insects associated in greatest numbers with cowpea plantings showing disease included the bean leaf-beetle (*Ceratoma trifurcata* Forst.), the belted cucumber beetle (*Diabrotica balteata* Lec.), the green stink-bug (*Nezara viridula* L.), and the alfalfa-infesting treehopper (*Stictocephala festina* Say).

Preliminary experiments during 1921 proved that the bean leaf-beetle transmitted the disease, while tests with the green stink-bug and the treehopper were negative. Additional experiments performed in 1922 and 1923 further demonstrated that the bean leaf-beetle is a definite and efficient carrier of cowpea mosaic.

It was established that insects which had fed for one day on diseased plants and were then transferred to healthy plants transmitted the disease in practically every case. Beetles retained as controls and confined on healthy plants did not transmit the disease when transferred to other healthy plants. Some infection of healthy plants was obtained by inoculation with regurgitated juice or abdominal contents from beetles which had previously fed on diseased plants.

Unmistakable symptoms of the disease were found to appear on healthy plants within five days after the beetles had been introduced into the cages containing these plants, but the average period throughout the season was seven days. In a few cases mosaic appeared on leaves which were very small at the time of inoculation, but as a general rule, only foliage appearing subsequent to inoculation developed readily recognizable symptoms of the disease.

Some artificial transmission of the disease was accomplished by rubbing the leaves of diseased and healthy plants together. In a limited number of experiments mosaic was readily transmitted from diseased to healthy plants by inoculation with a needle.

C. E. SMITH

BUREAU OF ENTOMOLOGY,
U. S. DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE DEPARTMENTS OF ENTOMOLOGY AND PLANT PATHOLOGY,
LOUISIANA STATE UNIVERSITY

ALKALINE REACTION OF THE COTTON PLANT

MR. C. M. SMITH in an article, "Excretions from the leaf as a factor in arsenical injury to plants," read before the New Haven meeting of the American Chemical Society, has pointed out that dew collected from the cotton plant is alkaline.

It seemed possible to the writer that this alkalinity was connected in some way with the attraction of the cotton plant for the boll weevil. The following experiments were therefore tried.

The leaves and stems of young cotton plants were crushed and immersed in water containing a few drops of phenol-phthalein. No apparent alkalinity was produced. (Distilled water was not available.)

When the unbruised plant was placed in the water containing the phenol-phthalein it was found that the under side of the leaf, the tender buds and very tender stems showed an alkaline reaction distinctly apparent by the almost immediate change in color of the phenol-phthalein adjacent thereto. No evidence of such alkalinity could be observed on the upper side of the leaf nor on the older parts of the stems, etc.

The solution of the alkaline substance in the water was apparently heavier than the water, as a distinct tendency for the purplish color to sink was noted.

On exposure of the under side of the leaf to the sun for some hours no apparent diminution in the alkalinity of the under side of the leaf took place.

Some thirty or forty different kinds of leaves were next tried in the same way. Similar, though much less, alkalinity was noted only in the case of leaves from okra. Since the okra is related to the cotton plant and since the boll weevil can be forced to feed upon this plant, some significance may attach to that fact. It is known, however, that certain other plants are known to form alkaline substances.

It was not possible at the time to attempt to identify the nature of the alkaline substances. Nor were forms, blooms or bolls available. Even the possibility of selective adsorption having produced the apparent alkalinity was not excluded.

Mr. Smith seems to think that there is something in his analysis of the dew (showing calcium and magnesium carbonates and bicarbonates) to account for the alkalinity observed. Since both acid and normal alkaline earth carbonates are neutral to phenolphthalein, this would hardly seem possible. Alkali carbonates, if present, would cause alkalinity. Careful examination should be made for the presence of an organic alkaline compound and to find if the alkalinity observed has anything to do with the preference of the boll weevil for the cotton plant.

J. E. MILLS

EDGEWOOD ARSENAL,
EDGEWOOD, MD.

ON THE INDUCTION OF ANTIRACHITIC PROPERTIES IN RATIONS BY EXPOSURE TO LIGHT

In the issue of September 5, 1924, of SCIENCE, Steenbock published a communication bearing a title similar to the above. He reported that by irradiation he was able to activate fats which were "otherwise negative in preventing rickets" so that they were rendered active and effected a rapid healing of lesions.

In this connection I wish to call attention to a similar investigation which was reported by me at the meeting of the American Pediatric Society, at Pittsfield, on June 7. These experiments consisted of irradiating various fluids with the mercury vapor quartz lamp. The results were summarized in this paper as follows: "that it was found that cotton seed oil when irradiated for an hour at a distance of one foot had acquired antirachitic properties. In order to exclude the possibility that the effect might be due to an antirachitic potency of cotton seed oil, linseed oil was substituted and the experiment carried out in the same way—0.1 cc. and 0.25 cc. being given daily to each rat. The same result was obtained, namely the development of rickets when non-irradiated oil was fed and the prevention of rickets when the oil was given which had been irradiated."

It may be added that the potency of cod liver oil is also enhanced by irradiation. It will be seen that the experiments which we have reported brought about results in regard to antirachitic actions which are similar to those recently communicated in this journal.

ALFRED F. HESS
DEPARTMENT OF PATHOLOGY, COLUMBIA UNIVERSITY, COLLEGE OF PHYSICIANS AND SURGEONS

SCIENTIFIC BOOKS

Effect of Variations in the Assumed Figure of the Earth on the Mapping of a Large Area. Special Publication No. 100 of the U. S. Coast and Geodetic Survey. By WALTER D. LAMBERT, Mathematician, Division of Geodesy.

THE question of how much correction to computed geographic positions would be required in the change from one spheroid of reference to another with slightly different elements of definition is one that must always be considered by the practical geodesist.

This publication attempts to give some idea of the magnitude of such changes from a consideration of an area such as that of the United States. The amount of exact computation requisite even for this general view of the matter is considerable; these computations have been carried out with sufficient precision and they are of value as concrete examples for such as wish to undertake similar calculations.

Heretofore the formulas and explanations of such computations have been scarcely, if at all, available in English. It is therefore with pleasure that we note that this small pamphlet gives the formulas for such work with an explanation that can be followed with ease even by those who may not be actively engaged in such work. The geodetic study of the figure and size of the earth should be of direct interest both to the engineer in a practical way and to the scientist who should take an active interest in the advancement of knowledge along all lines.

A feature of the publication that is to be commended is the table of comparison of symbols used by various authors given on page 35. One of the things that is always discouraging in reading scientific literature is the use of different notations for the same thing by different authors. Not the least of such offenders against clearness are the mathematicians both pure and applied. This table is therefore of great value to those who want to look into this question without too much preliminary study.

Since this publication furnishes authoritative information on some rather intricate questions of geodesy, it fills a place in English geodetic literature that should appeal in a special way to the scientific world.

O. S. ADAMS
U. S. COAST AND GEODETIC SURVEY
WASHINGTON, D. C.

The Evolution of the Universe, or Creation According to Science. Transmitted from MICHAEL FARADAY, late electrician and chemist of the Royal Institution of London. Cosmos Publishing Company, Los Angeles, California, 1924. $2.50.

MICHAEL FARADAY, one of the creators of the science of chemistry and a pioneer in investigations of electricity, died in 1867, at the age of seventy-six.

It will interest chemists and physicists to know that "after transition" to "the scientific spheres of the Spirit World," Faraday has continued his investigations of the "Major Vortex," which is "with other planetary conditions only one state of the Entity," and especially in regard to electrons and the mastery of "the imponderable forces of nature which control the incarnation of a mortal without whose agency the world would roll on for ages in the idealism of the savage types of man and the entities that would be caught in the vortexical currents of the incarnating processes," etc. And all this without once calling on the resources of mathematics, which indicates that formulae and equations are emanations of the material mind.

Without anticipating the discoveries promulgated by the master chemist derived through fifty years of freedom from hampering conditions, I hasten to say that these were presented all or chiefly through "electro-magnetic" "independent slate-writing" to a gen-

tleman in Los Angeles, who chooses to be known as the "Mystic Helper," assisted by a friend, the "Mystic Scribe." The last message received (1911) from Professor Faraday reads:

> Through my cherished instrument I will continue my work bringing to mankind the greatest and most helpful thoughts gleaned from my long experience in this realm of truth.

The book is written in a kindly and tolerant spirit, accepting current theories of evolution, and going a long way farther. It closes with a rhapsody to evolution in which "the mighty soul of the Potent All guides all the worlds their endless rounds." A companion piece is the "Song of the Atom," which lets us down a bit from the "pure-ethered height" of the other poem:

> Come in line my brothers all
> Let us make the Earth a ball.

And a ball it remains to this day!

The volume is illustrated by photographs of nebulae and the like, taken by astronomers, by portraits of Faraday, Tyndall and Franklin, noted physicists, and by a number of spirit photographs not mentioned in the test. Some of these are conventional materializations, but others illustrate the creative work of electrons which in their varied operations appear in irregular forms pure white in color, and about as large as snowflakes. Students of heredity will be interested in the microphotographs showing the "formation of cell by induction of earth's magnetic currents," the process of mitosis being due to their influence. It is remarkable what electrons will accomplish when once released from bondage to "mortal electricians, like Edison, Marconi and many others."

The editor of this volume expresses the hope that Faraday "may be able to continue his efforts until intellectual spirituality animates every soul born into Cosmic Existence in or upon any planet that shall ever exist in Realms of Evolutionary Experience."

DAVID STARR JORDAN

STANFORD UNIVERSITY

LABORATORY APPARATUS AND METHODS

BLOOD CORPUSCLE MOVEMENT IN THE RETINA FOR CLASSROOM DEMONSTRATION OF CIRCULATORY CHANGES

No doubt many persons, when looking at a dull sky, have observed indistinct faint specks which appear, move in definite pathways across the field of vision and then disappear. Upon suddenly arising from a bending position, or after a sneeze, the specks may become quite bright and distinct. They are the moving blood-corpuscles in the retinal capillaries and their movement is quite different from that of small particles in the humors of the eye, often so troublesome to users of the microscope. Subjective observation of the retinal circulation has been frequently described, but the advantages of the following method for viewing this phenomenon, first recorded by Rood in 1860, are not generally recognized.

Upon looking at a bright sky through a dense blue-violet glass (such as Corning G 585–L), the movement of the corpuscles stands out almost as clearly as in the web of the frog's foot, but the corpuscles are not seen as objects of such definite form nor are capillary outlines visible. One observes bright specks, somewhat elongated, often curved like a vibrio. The whole field of view seems filled with a mass of writhing bacteria, sometimes accelerated in movement corresponding to the heart-beats.

Any brilliant white surface instead of the sky will serve as a background. One may look at the sun itself if additional filters are used, say G 585-L, G 586–A and G 584–J, when the corpuscles appear very bright. It is perhaps well not to gaze at the sun too long, for these filters are quite transparent to the near ultra-violet.

Changes in blood velocity connected with pressure changes are easily observed. Thus, if one suddenly bends over and looks at the sky through the blue-violet glass, the blood velocity is much accelerated; upon straightening up, the flow instantly slows down and then regains its usual rate. By taking a deep inspiration, holding the nose and exerting pressure on the thoracic cavity, the circulation may be seen to slow down and almost stop. The retinal circulation is an index of what is going on in the brain and illustrates the decreased blood-flow which precedes fainting, since fainting frequently follows any prolonged increase in intrathoracic pressure.

By lying on the back and having an assistant suddenly raise the legs, changes in blood-flow due to hydrostatic pressure of blood in the legs, with compensatory after-effects, may be demonstrated. By pressing on the eyeball with the finger, the circulation in the retina may be much slowed or stopped, and the bright specks disappear just before the whole field of view becomes black. On releasing the pressure, the circulation again starts at a rapid rate. Changes of blood-flow due to exercise and many other effects, which will occur to those interested in blood circulation, may be observed with great ease. The simplicity of the method commends it for classroom work, and the student usually takes great interest in viewing for himself blood velocity changes in

his own body. The clinician may find the method useful where subjective answers may be relied upon.

Just why the corpuscles appear as bright somewhat elongated specks is questionable. I first observed the phenomenon on looking at a carbon arc focused to a parallel beam, passing through a combination Corning ultra-violet filter (G 586–A and G 584–J). I thought the effect was due to fluorescence of the white corpuscles but am now certain that is not the explanation.

If a small field is selected for observation the bright points, whose elongation I attribute to persistence of vision, are found to be not sufficiently numerous for red corpuscles. They move over the *same pathway* at infrequent intervals and must be white corpuscles. Nevertheless, there is a definite relation between the absorption spectrum of haemoglobin and the light in which one can see the moving corpuscles most plainly. Abelsdorff and Nagel showed that the moving corpuscles appear in light which haemoglobin absorbs. Thus they are visible in blue-violet but invisible in red light. One should expect that with a blue glass the continuous stream of red corpuscles would throw a shadow of the capillaries on the retinal elements. Yet we see no evidence of capillary loops or plexus in shadow form. No doubt this is because the capillaries are so near the retinal elements that their shadow is fixed. In the classic method of demonstrating the shadows of the *large* blood vessels over the *surface* of the retina by looking through a pinhole at a white surface, the pinhole must be moved so as to continually cast a bloodvessel shadow over new retinal elements. When the pinhole is fixed no shadows are visible, although shadows are continually cast upon the rods and cones. This corresponds to the condition where a continuous stream of red corpuscles moves through capillaries in blue light. Although each red corpuscle moves, the corpuscles overlap and the shadow is continuous. But when a white corpuscle comes along which does not absorb blue light, as the reds do, we have a rift in the shadow figure which corresponds to movement of a shadow across the rods and cones, analogous to the movement of the pinhole in the demonstration of the *large* retinal blood-vessels. Thus we see the white corpuscles by contrast with the reds and see them best in light which casts the best shadow. Red light passes both the red and white corpuscles and no contrast appears.

It so happens that the brightest lines of the mercury vapor lamp (the yellow, the green and the blue violet) lie in the position of oxyhaemoglobin absorption bands. One can therefore see the moving corpuscles of the retina very well by looking at a white matt surface illuminated by a mercury lamp; or by appropriate filters one can isolate each line and observe the moving corpuscles in yellow, green or blue violet light.

I recommend the above simple experiments to any one interested in the circulation of the blood or in subjective phenomena. They deserve to be more widely known than appears to be the case.

The literature on this subject is as follows:

Abelsdorff, G., "Arch. f. Anat. u. Physiol.," 1903, p. 366.

Abelsdorff, G., and Nagel, W. A., *Zeit. f. Psychol. u. Physiol. des Sinnesorgane, 34*, 291, 1904.

Fortin, E. P., *C. R. Soc. Biol., 62*, 355, 1907.

Helmholtz, H. von., "Physiologische Optik," 2nd Aufl., 1896, p. 198.

Reuben, L., *Amer. J. Sc., 31*, 325, 1861.

Rood, O. H., *Amer. J. Sc., 30*, 264 and 385, 1860.

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MICROPROJECTION BY THE DAYLIGHT SCREEN

IN the teaching of histology, organology and neurology the chief difficulty lies, not in making the students see the details of an organ, but rather in orienting for them the plane of section and the relationship of the main parts. It is next to impossible to persuade the student that a low power objective is far more important in the study of most sections than a 4 mm objective, and as a result he fails to obtain a true conception of relationships. Then, too, in personal demonstration six times out of ten the average student does not see that which you try to show him under his microscope. Again, it is impossible to properly demonstrate three or four slides in five or six minutes, which is the average time a demonstrator has per student in order to handle 15 to 20 of them. These difficulties, I am sure, are encountered not only by anatomists but also by embryologists and botanists.

It has been my experience that a short time spent during each laboratory period in projecting the slides to be studied, with a 48 mm, 25 mm or 16 mm objective and pointing out the plane of section and the relationships of the main structures will create an interest and give a viewpoint conducive to effective laboratory study. The best results are obtained by a ten to fifteen minute demonstration to ten to fifteen students at a time. Personal demonstration for this number of students would require from one and one half hours and would permit greater misinterpretation.

For the projection method of demonstrating sections the day-light screen is of great value, since it permits demonstration at one end of the laboratory without interrupting the work of the rest of the

students. The daylight screen now on the market has several objectionable features: in the first place, its lines are too coarse, thus destroying the details and also producing a glaring streak of light across it; in the second place the greenish tint destroys the true color value in arc-light projection; and in the third place the screen is too expensive. A screen which presents none of these objectionable features can be had in a piece of paraffined tracing-paper, a piece of paraffined tracing-cloth or a ground-glass plate.

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SPECIAL ARTICLES

THE PHOTOACTIVITY OF SUBSTANCES CURATIVE OF RICKETS AND THE PHOTOLYSIS OF THE OXY-PRODUCTS BY ULTRAVIOLET RADIATION

THE demonstration by Huldschinsky[1] and others that radiation with the quartz mercury vapor lamp or sunlight prevented and cured rickets, was a great advance in the knowledge of that disease. It had been proved also that cod liver oil prevents and cures rickets[2] and therefore the dilemma presented itself that two therapeutic agents apparently unrelated cure the disease. The one, a physical force derived from the sun, is absorbed through the skin, the other, an oil taken from the liver of a fish, enters the body by way of the alimentary tract. Nevertheless, investigation soon showed that in their action in rickets and infantile tetany radiant energy and cod liver oil are indistinguishable. No matter which of these apparently dissimilar therapeutic agents is employed, favorable clinical and roentgenological evidences of healing in rachitic subjects are demonstrable. With both, there is a similar latent period; with both, the normal equilibrium of calcium and inorganic phosphorus of the blood is reestablished; and furthermore, with both, the histological changes in the skeleton are identical. The similarity of the action of radiant energy and cod liver oil is so striking as to cause Park, Powers and Guy[3] to conclude, "The similarity between the action of cod liver oil and that of radiant energy in rickets is so close that a connection must exist between them. So far as the calcium and phosphorous metabolism of the body are concerned, cod liver oil seems to be a substitute for radiant energy. It will be most interesting to see if, in the near future, a relation between cod liver oil and radiant energy will not be established of such nature that these effects will be explicable on a single basis."

Investigations were therefore undertaken to determine the possible common property of radiant energy and the various substances curative of rickets. The present data is representative of a series of preliminary experiments for qualitative orientation and serve as a basis for quantitative study.

A. *The Emission of Ultraviolet Radiation by Substances Curative of Rickets.*

Method. Substances curative and non-curative of rickets were tested for their emission of ultraviolet light. They were placed in beakers and covered with specially prepared photographic plate holders. The plates were exposed to each substance for twenty-four hours, developed with pictol,[4] fixed, washed and dried.

The plate holder consisted of a shallow lead box of a size just large enough to admit the four inch by five inch photographic plate and a closely fitting cover of the same material. In the floor of the lead plate holder a hole two centimeters square was cut to allow the formation of a sharp photographic image. A quartz plate, either fused or transparent, was sealed over this aperture in such a way as to prevent the permeation of volatile substances from the test materials. Similar holders were made with glass screens. Ultraviolet sensitive plates[5] coated with a very rapid emulsion (Seed Graflex 60) were placed with the film surface in apposition with the quartz or glass screen and then covered by the lid. Each beaker covered by this plate holder was placed within a light-proof container which in turn was placed within a second light-proof container.

Three series of experiments were carried out on each substance. In the first series the substances were made alkaline with ten per cent. potassium hydroxide and this mixture was oxidized by bubbling through it a current of pure oxygen. In the second series the substances were untreated. In the third

[1] Huldschinsky, K., Deutsche med. Woch., 1919, XLV, 712; Zeitschr. f. Orthop. Chir., 1920, XXXIX, 426.

[2] Schabad, J. A., Zeitschr. f. klin. Med., 1909, LXVIII, 94; Shipley, P. G., Park, E. A., *et al.*, *J. Biochem.*, 1921, XLV, 343. Park E. A., and Howland, J., Johns Hopkins Hosp. Bull., 1921, XXXII, 341.

[3] Park, E. A., Powers, G. F., and Guy, R. A., *Am. J. Diseases Children*, 1923, XXVI, p. 111.

[4] Dissolve 3 oz. of desiccated sodium sulfite in 16 oz. distilled water and add this to a solution of 150 grains of hydroquinone in 8 oz. of distilled water. This constitutes solution A. Dissolve 2 oz. of potassium carbonate and 60 grains of potassium bromide in 16 oz. of water. This constitutes solution B. For use mix three parts of A with two parts of B.

[5] These are being replaced by Schumann plates for photographing the extreme ultraviolet region since gelatin exercises a very powerful absorptive influence upon rays of short wave length.

series they were reduced by ammonium ferro-tartrate. The beakers covered by the plate holders were placed in desiccators containing alkaline pyrogallol and were subsequently evacuated. These three series will be referred to as oxidized, untreated and reduced.

TABLE I

RESULTS OF THE FOGGING OF PHOTOGRAPHIC PLATES EXPOSED TO SUBSTANCES CURATIVE AND NON-CURATIVE OF RICKETS

Reaction	Substances Curative of Rickets			Substances Non-Curative of Rickets		
	Quartz screen	Glass screen	No screen	Quartz screen	Glass screen	No screen
Oxidation	+	0	+	0	0	+
Air Autoxidation	+	0	+	0	0	+
Reduction	0	0		0	0	

Results. The following substances curative of rickets—cod liver oil,[6] non-saponifiable fraction of cod liver oil,[7] oxidized cod liver oil treated to destroy Fat Soluble A,[8] egg yolk,[9], bile,[10] hydroquinone,[11] and sperm oil,[12]—when oxidized produced a definite blackening on photographic plate screened by quartz but not on those screened by glass. The substances non-curative of rickets, namely linseed oil,[13] peanut oil,[13] cotton seed oil,[13] lard,[14] the saponifiable fraction of cod liver oil,[7] and also crude oil, albolene and glycerine when oxidized did not affect the photographic plate through either quartz or glass. All oxidized substances examined fogged plates exposed to them without a screen.

The untreated substances curative of rickets blackened a sensitive plate through quartz but not through glass, on spontaneous autoxidation by the air within the beaker. The intensity of the image was not so marked as with the oxygenated substances. The untreated substances non-curative of rickets did not fog the plate through either quartz or glass.

The reduced substances curative and non-curative of rickets did not fog the sensitive plate through quartz or glass. The substances curative of rickets whose absorbed oxygen was removed by bubbling carbon dioxide through them under reduced pressure produced but very slight fogging of the plate.

Blood also fogs the photographic plate through quartz but not through glass. The degree of blackening increases with the rate of oxidation and decreases when oxidation is prevented by passing carbon dioxide through the blood.

B. *The Liberation of Oxygen from the Oxidized Substances Curative of Rickets by Ultraviolet Radiation.*

Oxidation resulted in the production of ultraviolet rays and therefore an attempt was made to determine the reversibility of this reaction. The substances curative of rickets which were oxidized in alkaline media were placed in a quartz test tube connected to a Torricellian mercury column and radiated by ultraviolet light at room temperature for three hours. Under the influence of the radiation a continuous formation of gas bubbles within the quartz tube was observed with a gradual dropping of the mercury caused by the gas formed. This was found to be oxygen.

The photo-chemical equilibrium in an unstirred solution that absorbs all active ultraviolet radiation is independent of the intensity of illumination, as would be expected, but is entirely dependent upon the extent of the surface exposed to the light source.[15]

Photolysis of the oxy-substances curative of rickets was not detectable in solutions that had been exposed to the ultraviolet light through glass test tubes which transmitted none of the shorter wave lengths.

Therefore, the reaction which takes place when substances curative of rickets are radiated with ultraviolet light seems to be the reverse of that obtained in the previous experiments, namely the emission of ultraviolet radiation upon oxidation.

Summary. The data presented show that the substances curative of rickets, upon oxidation blacken sensitive plates through quartz but not through glass screens. This phenomenon is undoubtedly due to the emission of ultraviolet radiation. The interposition of quartz plates excludes the effect of reducing vapors which otherwise blacken the sensitive plate. The non-

[6] *Loc. cit.*

[7] Zucker, T. F., Pappenheimer and Barnett, *Proc. Soc. Exp. Biol. and Med.*, 1922, XIX, 167.

[8] McCollum, E. V., Simmons, Nina, Baker, J. E., *J. Biol. Chem.*, 1922, 53, 293.

[9] Hess, Alfred F., *Proc. Soc. Exp. Biol. and Med.*, 1922, XX, 369; Casparis, H., Shipley, P. G., and Kramer, B., *J. Am. Med. Assoc.*, 81, 818, 1923.

[10] Kapsinow, R., and Jackson, D., *Proc. Soc. Exp. Biol. and Med.*, 1924, XXI, p. 472.

[11] Huston, A. C., and Lightbody, H. D., *J. Ind. and Eng. News*, April, 1924.

[12] Personal communication from Professor E. A. Park. —"So far as we are aware, sperm oil has never been tested for anti-rachitic property. However, Drummond (Biochem. J. XVI, 518, 1922) found it to contain Fat Soluble A. It is highly probable that the oils of all fish have anti-rachitic properties."

[13] Mellanby, E., British Med. Research Council Report No. 61, 1921, 22.

[14] Personal communication from Professor E. A. Park. —"Lard has no specific anti-rachitic effect." (Unpublished work).

[15] W. T. Anderson, Jr., *J. Am. Chem. Soc.*, 1924, 46, 801.